Journal of the Royal Society of Arts

NO. 4915 FRIDAY, 25TH DECEMBER, 1953 VOL. CII

FORTHCOMING MEETINGS

WEDNESDAY, 30TH DECEMBER, AT 2.30 p.m. DR. MANN JUVENILE LECTURE, '*Smugglers*', by Rupert C. Jarvis, F.S.A., F.R.Hist.S., Librarian, H.M. Customs and Excise. (Admission by special ticket only.)

MONDAY, 4TH JANUARY, AT 6.30 p.m. FILM EVENING. (See notice below.)

WEDNESDAY, 6TH JANUARY, AT 2.30 p.m. DR. MANN JUVENILE LECTURE. '*International Show Jumping*', by Lieut.-Colonel H. M. Llewellyn, C.B.E., M.A., M.F.H. (Admission by special ticket only.)

WEDNESDAY, 13TH JANUARY, AT 2.30 p.m. '*Stereo-Cinematography*', by Leslie Knopp, Ph.D., M.Sc., Technical Adviser, Cinematograph Exhibitors' Association of Great Britain and Ireland. Sir Henry French, G.B.E., K.C.B., Director-General, British Film Producers Association, will preside. The paper will be illustrated with lantern slides.

THURSDAY, 14TH JANUARY, AT 5.15 p.m. COMMONWEALTH SECTION. HENRY MORLEY LECTURE. '*The Colombo Plan*', by A. C. B. Symon, C.M.G., O.B.E., Assistant Under-Secretary, Commonwealth Relations Office. Sir Percival Griffiths, C.I.E., Honorary Adviser to the India, Pakistan and Burma Association, will preside. (Tea will be served from 4.30 p.m.)

FILM EVENING

The second Film Evening of the Session will be held on Monday, 4th January, at **6.30 p.m.** and the programme will consist of the following three films: *The Moving Spirit*, *Teeth of the Wind*, and *European Holiday*. These films have been chosen with a view to the possibility that some Fellows may care to bring their older children on this occasion.

Tickets of admission are not required, and Fellows are entitled to introduce two guests. Light refreshments will be served in the Library *beforehand* from 5.45 p.m., at a charge of 1*s*. per head.

The Moving Spirit (20 minutes) is a Technicolour cartoon film produced for the Anglo-Iranian Oil Co., by Halas & Batchelor Cartoon Films Ltd., and

won a first prize at the 1953 Venice Festival. The film traces the development of the motor-car from the horseless carriages of the 'eighties down to the streamlined automobile of to-day.

Teeth of the Wind (28 minutes) is a straightforward documentary produced by World Wide Pictures Ltd. for the Mutual Security Agency (British Mission) and vividly portrays the menace of the locust, as well as the increasing co-operation among nations which is helping to control it.

European Holiday (45 minutes) is a Kodachrome film produced by Carillon Films, Amsterdam, for K.L.M. Royal Dutch Airlines and in a rather witty and light-hearted way contrasts the architecture, music, languages, sports, costume, etc., of the various countries of Western Europe.

About 150 Fellows and their friends attended the first Film Evening on Friday, 4th December. *Persian Story* and *Full Circle* were introduced by Mr. Ian Latimer (Production Manager) and Mr. Peter Sachs (Director) respectively.

THE SOCIETY'S BICENTENARY CELEBRATIONS

The main details of the Bicentenary celebrations have now been settled and full particulars will be posted direct to every Fellow early in the New Year. With this information will be included an application form for each function, and Fellows, other than those resident overseas, are particularly requested to apply for tickets by means of these forms and not by letter.

MEETING OF COUNCIL

A meeting of Council was held on Monday, 14th December, 1953. Present: Sir Ernest Goodale (in the Chair); Mr. F. H. Andrews; Sir Frank Brown; Sir Edward Crowe; Sir John Forsdyke; Mr. P. A. Le Neve Foster; Mr. John Gloag; Dame Caroline Haslett; Dr. R. W. Holland; Lord Horder; Sir Harry Lindsay; Mr. F. A. Mercer; Mr. J. A. Milne; Mr. O. P. Milne; Mr. E. M. Rich; Professor A. E. Richardson; Sir Andrew Rowell; Sir Harold Saunders; Sir John Simonsen; Sir Stephen Tallents; Sir John Woodhead, and Miss Anna Zinkeisen; with Mr. K. W. Luckhurst (Secretary) and Mr. R. V. C. Cleveland-Stevens (Assistant Secretary).

ELECTIONS

The following candidates were duly elected Fellows of the Society:

Adler, Earle Raymond, London.
Anderson, Robert, Glasgow.
Aratoon, B. P., Rangoon, Burma.
Arnold, Cyril, Belleek, Northern Ireland.
Beamish, Henry Hamilton, Kuala Lumpur, Malaya.
Billimoria, Homi Framjee, B.Arch., F.R.I.B.A., Colombo, Ceylon.
Blott, John Arthur, Blackmore, Essex.
Bottomley, Hugh, Keighley, Yorks.
Brown, George Hamilton, Dalkeith, Midlothian.
Bullivant, Brian Milton, Richmond, Surrey.

Butterworth, John, Southport, Lancs.
Carrier, Louis, Ste-Anne de Bellevue, Quebec, Canada.
Chaudhry, Manoharlal, M.A., LL.B., New Delhi, India.
Cooper, Professor Douglas LeBaron, M.Sc., Ph.D., St. John's, Newfoundland, Canada.
Cresswell, The Rev. Cyril Leonard, C.V.O., M.A., F.S.A., Elstead, Surrey.
Crooks, Maxwell, Bournemouth, Hants.
Cullen, Ernest Walter, Truro, Cornwall.
DaBoll, Raymond Franklin, Newark, Arkansas, U.S.A.
Debono, Joseph, Sliema, Malta, G.C.
DeRyck, Charles, M.M., London.
Du Bern, Guy Eric, Rangoon, Burma.
Eason, Miss Ursula Vernon, B.A., London.
English, Gordon Clarkson, Montreal, Quebec, Canada.
Fancy, Amirali H., Karachi, Pakistan.
Fisher, Donald Shives, Sackville, New Brunswick, Canada.
Galliara, R. K., Rangoon, Burma.
Galwey, Miss Margaret Louise, London.
Gandhi, R. R., Rangoon, Burma.
Gardner, Miss Joan Dorothea, London.
Garsia, Miss Beryl LeMesurier, Epsom, Surrey.
Gee, Ben, Keighley, Yorks.
George, The Rev. William Llewelyn John, M.A., Brighton, Sussex.
Gibson, Alexander Edward Charles, A.M.I.E.E., Lahore, Pakistan.
Gordon, Garnet Hamilton, C.B.E., St. Lucia, British West Indies.
Goslett, Miss Dorothy Frances Mary, London.
Gupta, Lakshmi Narayan, B.Sc., Hyderabad-Deccan, India.
Hall, William Henry, Bornova, Turkey.
Hollingsworth, D. T., M.I.E.E., Gerrards Cross, Bucks.
Holman, Miss Marigold Grace Trevenen, London.
Holmes, Ernest, Leeds, Yorks.
Huldt, Ake H., Stockholm, Sweden.
Ivens, Edgar, Stanmore, Middx.
Jariwala, Lallubhai Chakuram, D.Sc., J.P., Lalbaug, Bombay, India.
Johns, Edgar Francis, Southport, Lancs.
Keeling, Sir John Henry, Sedlescombe, Sussex.
Kemp, Roland John, Broomfield, Essex.
Kiffin-Petersen, Raymond, Madras, India.
Kellock, David Laylor, Ballarat, Victoria, Australia.
Knowles, Miss Eleanor Mary, O.B.E., L.D.S., London.
Large, Cyril Victor, B.Com., Johannesburg, South Africa.
Large, William Edward John, Theydon Bois, Essex.
Levert, Benjamin Norman, Johannesburg, South Africa.
Lloyd, Clive Leonel, Dartford, Kent.
Lloyd, Eynon, M.A., Newbridge, Mon.
Lockspeiser, Sir Ben, K.C.B., F.R.S., London.
Lyman, Professor John Goodwin, Montreal, Quebec, Canada.
MacNamara, Francis Xavier, B.A., B.Com., Middle East Air Force.
Mardon, John Kenric La Touche, D.S.O., T.D., J.P., Bristol.
McWhinnie, Hugh Alexander John, O.B.E., London.
Milne, John Erskine, Eccles, Lancs.
Mitchell, William Blanchard, Carlisle, Cumberland.
Morgan, F. Cleveland, M.A., Montreal, Quebec, Canada.
Munn, Professor Allan Macgregor, M.Sc., Ph.D., Ottawa, Ontario, Canada.

Neville, Maurice Raymond, M.C., M.A., A.M.I.E.E., Walton-on-Thames, Surrey.
Oliver, John Walter, M.A., D.Litt., Edinburgh.
Parish, David Elmer Woodbine, London.
Raden, Lee M., Elkins Park, Pennsylvania, U.S.A.
Radnor, The Right Honble. the Countess of, Salisbury, Wilts.
Rodmell, Herbert, Cottingham, Yorks.
Rooke, Alfred, A.C.I.S., Brierley, Yorks.
Rubner, Frank, Chigwell, Essex.
Salkeld, William Francis Graham, Ashurst, Kent.
Scott, Laurence Prestwich, B.A., Manchester.
Sebastian, Peter, B.A., B.Com., London.
Sein, U Aung, Rangoon, Burma.
Sherlock, Miss Lois Doreen, A.R.C.A., D.A., Norwich, Norfolk.
Slade, Lionel John Charles, London.
Smith, Albert Edward, Boreham Wood, Herts.
Smitley, Robert Lincoln, A.B., Englewood, New Jersey, U.S.A.
Stanley, John James, Preston, Lancs.
Stewart, Cecil Thornley, Port St. John's, Pondoland, South Africa.
Stokes, Donald Gresham, A.M.I.Mech.E., London.
Thomas, Major Raymond, Salisbury, Wilts.
Thornton, Mrs. Mildred Valley, Vancouver, British Columbia, Canada.
Valderrama, Dr. Esteban, Habana, Cuba.
Watson, Harold Henry, B.Sc., Ralston, Alberta, Canada.
Wilson, Harry Reuben, Harrow-on-the-Hill, Middx.
Wilson, Jack Loake, M.C., F.A.I., Rushden, Northants.
Woollatt, Kenneth Edgar, A.C.W.A., Peterborough, Northants.
Wallace, George Rae, Maidenhead, Berks.

Admitted under Bye-Law 66:

The Royal Holloway College, Surrey.

HONORARY CORRESPONDING MEMBER IN HONG KONG

Mr. C. W. Johnson, Manager of the Hong Kong branch of Messrs. Babcock & Wilcox Ltd., was appointed Honorary Corresponding Member in Hong Kong.

250TH ANNIVERSARY OF THE BIRTH OF BENJAMIN FRANKLIN

The Council accepted an invitation to the Society from the Franklin Institute to join the Committee of Sponsors of the international celebration, in January, 1956, of the 250th anniversary of the birth of Benjamin Franklin, who was a member of the Society.

BICENTENARY CELEBRATIONS

Further consideration was given to the arrangements for celebrating the Society's Bicentenary. (See notice above.)

EXAMINATIONS

It was reported that the total number of entries for the Autumn series of examinations was 11,056.

OTHER BUSINESS

A quantity of financial and other business was transacted.

THE DEVELOPMENT OF THE ST. LAWRENCE WATERWAY

The Neil Matheson McWharrie Lecture by

J. F. GRANDY, B.A., B.Phil.,

Office of the High Commissioner for Canada, delivered to the Commonwealth Section, on Thursday, 10th December, 1953, with Graham Spry, M.A., Agent-General for Saskatchewan, in the Chair

THE CHAIRMAN: He who presides has two characteristics: he is at once a chair and a man. I propose for most of the time to observe those qualities associated with a chair, which is not an animate and speaking animal. In my capacity as a man I have three things to say: first, this lecture is in honour of the memory of the late Neil Matheson McWharrie, and was established by his wife; secondly, the lecturer, who will speak in his personal capacity, is Mr. J. F. Grandy of the Canadian Diplomatic Service, at present serving in the office of the High Commissioner in London. He is a former Rhodes scholar at Christ Church, Oxford, and served in the Canadian Army during the war. Thirdly, his subject is the development of the St. Lawrence Waterway, in the study of which he was engaged when serving in the Department of External Affairs at Ottawa. I repeat he is speaking in his personal capacity, and not issuing a governmental pronunciamento.

With these words, unless there be on the part of this audience any illicit outburst of turbulence or unseemly ribaldry, I resume the grateful silence of the chair—my second capacity—and call upon Mr. Grandy to address you.

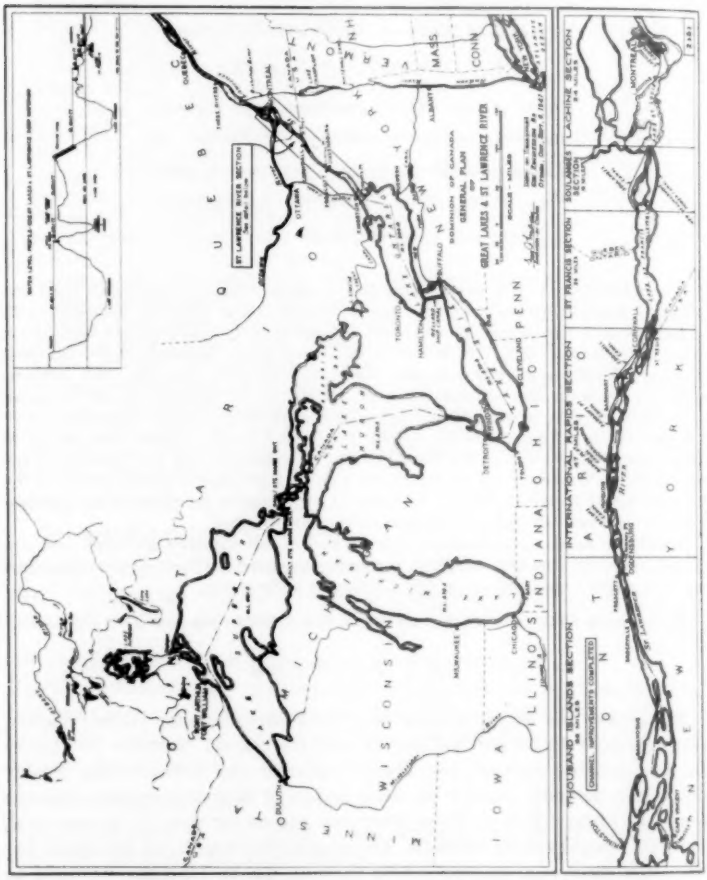
The following lecture, which was illustrated with lantern slides, was then delivered:

THE LECTURE

It is almost four hundred years since the French explorer, Jacques Cartier, passed through the Gulf of St. Lawrence into the majestic river that the Indians had told him had no end. The French explorers who followed him, notably Champlain, naturally made it the main avenue of their investigations into the hinterland of New France. There were two reasons for this: the geographical, and what I might call the romantic. The geographical reason was the simple fact that when there were no land communications the St. Lawrence provided an obvious and a most serviceable route for hundreds of miles inland. The more romantic reason was the persistent search, begun I suppose by Columbus, to find a westward sea passage to India and China.

But it was not only when land communication was impossible that the St. Lawrence provided a useful route to the centre of what proved to be a vast continent. When competing means of transport were developed, the St. Lawrence

route, as is usually the case with water routes, remained the cheapest method of conveyance, except for products where speed was a main consideration. Some historians attribute to the existence of this water highway the fact that Canada developed along east-west lines and became differentiated from the neighbouring



A map of the Great Lakes and the St. Lawrence river; with (below) a section of the St. Lawrence on a larger scale

colonies to the south, with the eventual result that two nations instead of one arose in North America.

The St. Lawrence and Great Lakes system together may best be considered as a river rising in the middle of the continent and flowing over 2,000 miles to the Atlantic ocean, that is, from the head of Lake Superior to Belle Isle, where the Gulf of St. Lawrence merges into the Atlantic. The first thousand miles from

Belle Isle to Montreal are freely navigable during the open water season. The rest of the system, that is, the upper St. Lawrence river, the Great Lakes and their connecting channels, consisted in their natural state of large freely navigable sections divided by natural obstacles which barred navigation from passing from one section to another. The main barriers were the various rapids in the St. Lawrence river itself, the falls at Niagara, and the rapids at Sault Ste. Marie. In addition, some channels at places such as the Detroit River, while deep enough for small vessels, would have been too shallow for the lake vessels that are now in service.

It is no paradox to say that in addition to being the main obstacles to navigation in the Great Lakes-St. Lawrence system, these barriers are also its great source of wealth, for they mean significant drops in the water level, and can therefore be large sources of hydro-electric power.

When the fur trade was in its prime, and the principal form of transportation the canoe, it was possible to go from Montreal up to Lake Ontario with the occasional portage around the rapids. The development of the St. Lawrence waterway, that is to say, the artificial improvement of the channels where there were rapids or other barriers, began around 1700 when a one and a half foot canal at the River St. Pierre near Lachine was constructed. To put it into perspective for you it can be said that the development of the waterway thus began some fifty years before your Society was formed.

There are five natural divisions of the St. Lawrence River above Montreal. The Lachine section, 24 miles long, extends from Montreal to Lake St. Louis. Within it there is a drop in water surface levels of about 48 feet, most of this between Montreal and Lachine. The one and a half foot canal was followed in 1780 and 1804 by short side canals at the edge of the rapids with a depth of two or three feet. The first Lachine Canal proper was finished by 1824, giving a depth of five feet of water. This was deepened first to nine feet, and later to the present depth of fourteen feet by 1884.

The next section, the Soulanges section, 18 miles long, extends from the head of Lake St. Louis to the foot of Lake St. Francis, with a difference in water levels of about 83 feet. Here again there have been various canals, the present one being the Soulanges Canal which was completed in 1899, providing for 14-foot navigation. There is also, however, on the south side of the river the Beauharnois hydro-electric power canal, which has been designed for a 27-foot channel.

Third is the Lake St. Francis section which, except for a few shoals, provides ample depth for 27-foot navigation.

These first three sections of the river are entirely within Canadian territory, while the next two sections are bounded by the Province of Ontario in the north, and the State of New York in the south.

The fourth is the International Rapids section, which extends from the head of Lake St. Francis to about four miles east of Prescott, 47 miles long, with a drop in water level of about 92 feet. This drop is overcome by a series of five canals which now provide 14-foot navigation.

Finally, there is the Thousand Islands section which extends from about four miles below Prescott to Lake Ontario, about 68 miles. The channels in this section have been deepened to a depth of 27 feet.

Passing on to the obstacle presented by the Niagara River and Falls, there is the Welland Ship Canal connecting Lakes Ontario and Erie, with a difference in elevation of 327 feet. This is the fourth Welland Canal: it was completed in 1932. It contains eight locks, all of which are 80 feet wide with 30 feet of water on the sills. Although there is a little more dredging to be done in the canal, no further construction is needed to provide a 27-foot depth throughout.

The channels in the Detroit river, Lake St. Clair and the St. Clair river, which connect Lake Erie with Lake Huron have been deepened progressively by the United States Government until at the present time a depth of 20 feet is available in the up-bound channels and 25 feet in down-bound channels.

The final obstacle to free navigation was the St. Mary's river, which connects Lake Huron and Lake Superior at Sault Ste. Marie. Here there is a drop of about 21½ feet. The first canal was built in 1797. At the present time there are two canals, one on the Canadian side with a depth of 18 feet, and one on the American side meeting the same standards as the Welland Canal with 30 feet of water on the sills.

By 1900 there was a continuous system of navigation of 14-foot depth from the upper lakes to Montreal. To-day there is still only a 14-foot system between Prescott and Montreal, while above Prescott Channel a depth of 20 feet is available up-bound and 25 feet down-bound. The only important obstacle to deep water navigation is the section between Prescott and Montreal. Although the 14-foot system was not completed until 1900, agitation for deep water navigation was well under way by the 1890s, and the first commissions of enquiry were appointed by the United States and Canadian Governments in 1895.

In 1910 the International Joint Commission was established in accordance with the Boundary Waters Treaty of 1909 between Canada and the United States primarily to deal with problems affecting the use of waters constituting or crossing the international boundary. Ten years later the two governments referred the whole question of navigation and power in the St. Lawrence river to this Commission. The report of the Commission favoured the development of the river for deep water navigation and hydro-electric power, but recommended further study. An International Joint Board of Engineers was accordingly appointed in 1924. This Board reported in favour of the project in 1926, and in 1932 a treaty providing for the construction of the deep waterway and power scheme was signed by the two governments. The treaty, however, failed to obtain a two-thirds majority in the United States Senate. After further negotiations the treaty was replaced in 1941 by an agreement between the two governments, that is, from the United States point of view a so-called 'executive agreement', requiring a simple majority in both Houses of Congress instead of a two-thirds majority in the Senate. Despite the strong support of each successive United States Administration, it has not proved possible to obtain the necessary vote in the United States Congress.

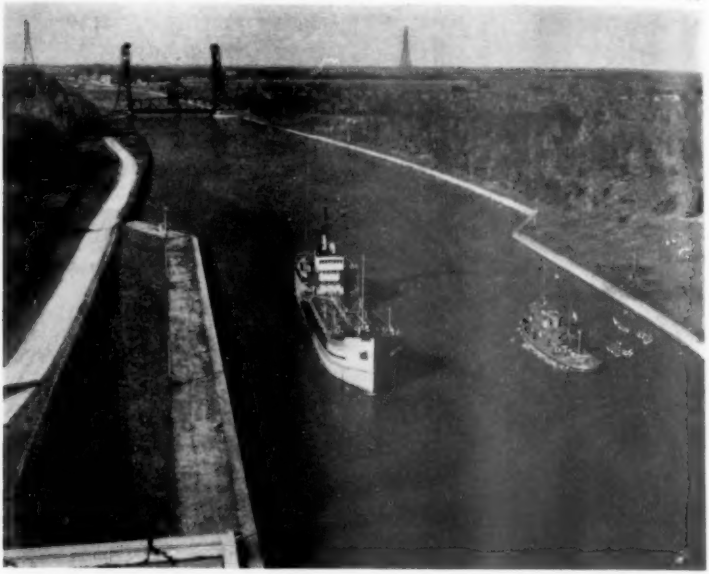
[National Film Board of Canada

The Soulanges (14-foot) Canal

The 1941 agreement, however, is in large part the basis from the engineering point of view of the present plans that I shall describe later. For this reason it is worth glancing at its main features.

It provided for the construction of the remaining links of a 27-foot waterway from the head of the Great Lakes to Montreal, and for a power scheme in conjunction with the navigation works in the International Rapids Section of the St. Lawrence. Leaving aside for the moment the International Rapids Section, the works that remain to be done to complete the scheme envisaged in the agreement are the following: some channel dredging in the upper lakes; dredging in the Welland Canal; the construction of a channel in the Lake St. Francis Section; the construction of a channel, a short canal, and several bridges in the Soulanges Section; and, finally, the development of the Lachine Section, either for navigation alone, or for navigation and power. There is a good deal of work to be done in this section, which leads into Montreal Harbour. The construction of power facilities would create a source of 1,200,000 horse-power immediately adjacent to the large industrial area around Montreal.

To return now to the International Rapids Section, the following are the main engineering works envisaged: (*a*) a control dam in the vicinity of Iroquois Point; (*b*) a dam in the Long Sault Rapids at the head of Barnhart Island and two power



[National Film Board of Canada

The Welland Canal

houses, one on each side of the international boundary, at the foot of Barnhart Island; (*c*) a side canal to carry navigation around the control dam and another south of Barnhart Island to bypass the main Long Sault dam; (*d*) a number of dykes, channel enlargements and railway and highway relocations; and, (*e*) the reconstruction of the village of Iroquois and part of Morrisburg, which would be inundated when the river were dammed.

So far I have spoken of the project mainly from the point of view of navigation. I think it is true to say, however, that in recent years the need of hydro-electric power has been an even more important consideration in the minds of many advocates of the project. This is particularly true of the authorities in the Province of Ontario and the State of New York. The power development at Barnhart Island would make use of a drop in water level of some 90 feet and would provide about 2,200,000 horse-power to be divided equally between the United States and Canada.

In 1948 the Ontario Hydro-Electric Power Commission and the Power Authority of the State of New York submitted identical applications to the International Joint Commission seeking approval of specific plans for the joint development by the two power authorities of the hydro-electric power resources of the International Rapids Section. It is a rule, however, that such applications if they are to be considered by the Commission must have the approval of the

two Federal Governments, and must be passed through them to the Commission. At that time the two Governments, in the hope that the United States Congress would act on the 1941 agreement, did not transmit to the Commission these applications for a separate power project. By December, 1951, however, it seemed clear to the Canadian Government that early action by Congress was unlikely, and it was decided to propose to the United States Government that the Ontario and New York State power authorities should be permitted to submit new applications to the International Joint Commission which would have the approval of the two Federal Governments. It was also decided that if the United States Government agreed to this, and the applications for the power development were approved by the International Joint Commission, the Canadian Government would be willing on its own to construct the deep water navigation works in the International Rapids Section, as well as in the purely Canadian sections from there down to Montreal.

I must digress at this point to explain why this so-called all-Canadian deep waterway must be conditional upon an international power development. The Boundary Waters Treaty of 1909, mentioned earlier, provided among many other things that either country could in effect do what it liked on its own side of a boundary water as long as it would not thereby affect the water level. If it were feasible to deepen the present 14-foot canals to 27 feet, Canada could develop its own deep waterway without affecting the level of water in the river, and therefore without depending in any way upon United States co-operation. But this would be uneconomic: it is too expensive to cut that much depth in what is mostly solid rock. The only practicable method is to provide depth by damming the river at a

[*Department of External Affairs*

Iroquois, Ontario. This village will be flooded out

suitable point, and damming a boundary water must be an international project. In any case, this would really be the only sensible way to proceed, for a method that excluded the power dam would perpetuate the waste of 2,200,000 horse-power of cheap electricity.

An approach along these lines was made to the United States Government, and in June, 1952, the Governments of Canada and the United States submitted applications to the International Joint Commission requesting approval of plans for the construction of the power works in the International Rapids Section. In these applications Canada's intention to complete the works necessary to provide a deep waterway as far as Lake Erie was noted. In October, 1952, the International Joint Commission approved these plans, and on November 4th the Canadian Government notified the United States Government that it now considered the 1941 agreement providing for the joint development of the whole project to be superseded by these events.

A year ago, therefore, everything was ready from the Canadian point of view for the scheme to go ahead on this basis, with the Canadian Government paying for the navigation works, and the Province of Ontario or the Hydro-Electric Power Commission of Ontario constructing and paying for the power works on the Canadian side. An agreement had previously been concluded by the Canadian Government with the Government of Ontario to arrange this division of

[*Malak Studio, Ottawa*

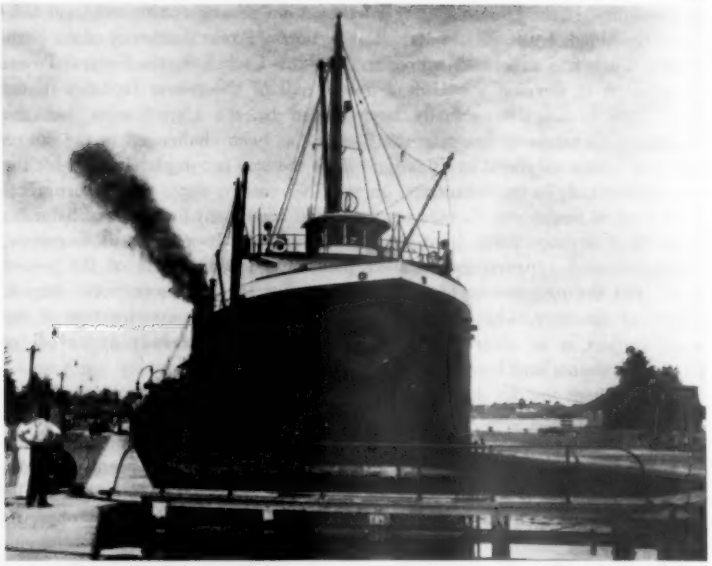
Model of the main works to be built at Barnhart Island

responsibility. In the United States, however, some administrative and legal difficulties remained. Under the Federal Power Act the Power Authority of the State of New York had to obtain a licence from the United States Federal Power Commission to develop the United States half of the power facilities in the river. This licence has actually been issued by the Commission, but the Commission's action in granting the licence has been challenged in the courts and some time may elapse in litigation before the way is completely clear for the work to proceed. In the meantime, on 12th November, 1953, the Governments of the United States and Canada concluded an agreement for the establishment of the St. Lawrence River Joint Board of Engineers. Its purpose is to review, co-ordinate and approve the detailed plans and specifications of the power works, and the programme for their construction in the International Rapids Section of the river. The Board is also to ensure that the construction of the power project is in accordance with the requirements already approved by both governments and by the International Joint Commission.

That is where the development of the scheme stands at the moment. I have spent a considerable time on this account of past history and recent progress, partly in order to impress upon you the fact that the development of the St. Lawrence waterway has been going on for a very long time, and partly in order to clarify the rather complicated diplomatic and legal negotiations of the past few years which have, I think, tended to leave the ordinary observer confused unless he has followed each move closely. There have, as you can see, been a good many difficulties of a constitutional or legal nature in the way of the approach that is now being followed. These have had to be cleared away one by one, and looked at in that light the progress has been substantial.

If the project goes ahead in this fashion there will be certain changes of the plans embodied in the 1941 agreement. Some of the navigation works in the International Rapids Section which were to be constructed on the United States side of the river will have to be built on the Canadian side, and the 27-foot depth will be provided by the Canadian Government only as far as Lake Erie. This is not a very serious limitation, since from Lake Erie on to the head of the lakes the channels already provide for 20 feet up-bound and 25 feet down-bound, and in the future no doubt further dredging of these channels could be undertaken by either country without undue difficulty. The works to be done in the Canadian section of the St. Lawrence river need be no different under this scheme than under the other. In either case these works would have been built and paid for by Canada, whereas the navigation works in the International Section that were to have been constructed and paid for by the United States will now be carried out by Canada. The power project will be constructed jointly by the Ontario and New York agencies concerned, who will each be responsible for their own half.

The cost to the Canadian Government of the proposed navigation works between Montreal and Lake Ontario, and of the dredging that remains to be done in the Welland Canal, has been estimated at about $250 million



[Department of External Affairs

The present locks at Dickinson's Landing

at December, 1950 prices. The St. Lawrence Seaway Authority which is to be established in Canada by Act of Parliament to carry out the work will be authorized to raise by way of bond issues $300 million. The annual interest charges on an expenditure of $250 million together with operating and maintenance costs and provision for amortization over fifty years would be around $17 million a year. If the cost is greater than $250 million—as it no doubt will be at present prices—this figure might be about $20 million a year. The Authority will be empowered to impose tolls on traffic using these works at rates adequate to recover these annual costs and so liquidate the scheme in not more than fifty years.

I now turn to examine what the deep waterway is expected to achieve and describe some of the opposition to it, and I shall follow that with a comparison of the savings that it is expected to bring about in transportation costs with the figure of annual operating, maintenance and carrying sharges that I have just given.

It has always been particularly important in North America to provide the cheapest possible means of transportation because of the long distances that must be covered. This is perhaps even more true in Canada than in the United States. Our population is smaller and local markets are often not available for most of the main products of an individual area. Moreover, we depend a good deal

more on international trade than does the United States, and it is therefore important to keep the costs of transportation to the seaboard as low as possible, and conversely to avoid having to add heavy inland transportation charges to the cost of imported goods. A further reason for Canada's especial interest in the St. Lawrence waterway is the existence in Canada of serious natural barriers to overland communication. The most important of these is the rugged country north of Lake Superior. Nevertheless, the people and industries in the United States that have any significant interest in the east-west movement of trade recognize the benefits they would gain from the opening up of the last serious obstacle to deep water navigation, and many of them have worked very hard to bring about United States participation in the project.

When the project was first put forward, and later when the first treaty was signed, the movement of grain from the Western prairies was by far the most important function the waterway was expected to serve. It is still one of the most important functions, but it is now expected to be surpassed in importance by the movement of iron ore from the Quebec–Labrador region through the new port of Seven Islands east of Montreal up into Lake Erie to serve the steel industry in that area. As you know, the development of this iron ore is well under way. Without the St. Lawrence waterway the ore will move by sea to Baltimore for use by the Atlantic coast steel mills, or for trans-shipment by rail to Pennsylvania, but the least expensive way of getting ore from Seven Islands to Pittsburg will be through the St. Lawrence waterway. The difference in transportation costs is so significant that it is thought that when the deep waterway is in operation, the extraction of the ten million tons of ore a year which is now planned can be doubled. The direction of this movement is particularly fortunate, for previous studies of potential traffic had had to assume a good deal of movement of shipping from east to west in ballast. It is logical to suppose that the ore carriers would now return down the system carrying coal from Pennsylvania, or else would go on to the head of the lakes after unloading their ore and return with wheat. There might very well therefore be a movement from east to west of say 15 million tons of iron ore and from west to east of something like ten million tons of grain, and possibly four million tons of coal. Other likely products are pulp and paper, automobiles, and a number of small miscellaneous items.

While these purely economic considerations constitute the main case for the navigation project, it is also expected to be of considerable value to both countries from the point of view of defence. One reason for this, of course, is that in wartime the railways in North America and the 14-foot canal system are under very heavy strain, and are sometimes a limiting factor on what can be produced and moved. There is also a narrower reason, however. The deep waterway would make possible the construction and repair of all but the largest vessels in protected shipyards hundreds of miles from the sea.

The arguments against the project come from a variety of sources, many of them naturally enough organizations who believe rightly or wrongly that the opening up of the St. Lawrence to deep water navigation will be a serious threat

to their own commercial interests. Some of the United States railroads and a number of Atlantic ports have played a leading role in opposing the project for reasons such as this. There have also been objections, on budgetary grounds, from some people who believe that the scheme will be wildly expensive, that the final cost will prove to be two or three times what is estimated, and that the project can never pay its way, especially as it will be ice-bound five months in the year. You will notice a fundamental difference between these two arguments. If the transportation interests who think they are threatened are right in their belief, those who believe the scheme to be uneconomic must be equally wrong. My own belief is that the scheme will fully pay its way, but that competing forms of transportation are unlikely in the long run to suffer very much and indeed may well benefit from the increased industrial activity that the seaway will induce. Incidentally, it is not difficult to dispose of the argument about ice. It is true enough that the navigation facilities will be ice-bound for about five months in each year, but this has been taken fully into account in the estimates of traffic that have been made, and it is worth pointing out that the canals at Sault Ste. Marie, which are ice-bound for just as long, nevertheless manage to handle more traffic in a year than the Panama, Suez and Kiel Canals taken together. On the question of cost, critics point to the fact that many other great engineering projects, notably the Panama Canal, eventually cost far more than was originally estimated. There is, however, a great deal of difference between the accuracy that can reasonably be expected of estimates for a project such as the St. Lawrence scheme where the engineering problems to be overcome are fully understood, and the inevitable unreliability of estimates for the Panama Canal where so many serious and unexpected difficulties had to be solved.

You will notice that most of the opposition to this project emanates from United States sources. While there are, of course, some people in Canada who are not in favour of it, they appear to be neither numerous nor influential. All the main political parties are agreed on its desirability. The City of Montreal which once feared that its interests would be injured by the deep waterway has now come around to the belief that the project is more likely to increase than to decrease Montreal's importance. I think this is true. Apart from iron ore carriers, the bulk of the traffic using the deep waterway will probably be freighters from the Great Lakes coming down to Montreal to trans-ship their cargoes to ocean liners. The effect of the waterway would be to cut out the extra trans-shipment at Prescott, and to increase the volume of cargo and the speed at which it can be handled. I think the railroads also recognize the value of this project. I have seen no reference to the views of the Canadian Pacific, but Mr. Donald Gordon, President of the Canadian National, was reported in the Press not long ago as answering a question about the waterway with the statement that 'whatever tends to open Canada up and help it grow is good for this railroad'.

It is not easy to put into precise monetary terms the value of the contribution the new navigation works will make, but one estimate that has been made is that it will result in a saving in transportation costs of $45 million a year, covering United States as well as Canadian traffic. You will remember that the annual

[*National Film Board of Canada*

The harbour at Port Arthur, Ontario

charges were estimated at something between $17 and $20 million a year, and even if the annual charges proved to be somewhat higher and the actual savings somewhat lower than these figures suggest, it should not be difficult to recover the cost of the project through the imposition of tolls such as would not divert traffic away from this route.

If this account of the St. Lawrence project has been unduly prosaic I hope it has not entirely obscured the romance that is attached to this scheme, nor the imagination that lies behind it. For Canada this will be a great adventure, comparable in many ways with the construction of the Canadian Pacific seventy years ago, and its consequences may prove to be equally far-reaching.

DISCUSSION

THE CHAIRMAN: A discredited and now, happily, deceased Italian once referred to the Mediterranean not as the *via* but as the *vita* of his country. The St. Lawrence has been the shaping and decisive force—the '*vita*'—in the transcontinental direction of Canadian development, and we have had to-day a clear, precise and accurate account of the new developments which that waterway is about to undergo.

MR. WILLIAM MACGILLIVRAY: May I ask first when the St. Lawrence waterway is going to be finished? I have heard that it will be about ten years. A second point: if there is going to be a draft of 27 ft. 6 ins. for a long way up the Lakes it will presumably not be necessary to trans-ship at Montreal, and ships will be able to come right through to England. This draft represents about 10,000 tons of cargo, or very nearly so.

THE LECTURER: On the first question, my guess is that it would take about six years to build, once construction starts, but, as I say, it cannot start until the last legal obstacles are overcome in the States.

On the second point, there is no reason why a 10,000 ton ship could not go all the way from here to Fort William, but it may be that a good many of them will not find it worth their while to take the time needed to work their way up the waterway through all the locks. The lakers have not been able to come up to Montreal before, and I think a good many of them will want to do so. The lakers are not designed to cross the ocean; they have a curious construction of their own.

SIR SELWYN SELWYN-CLARKE, K.B.E., C.M.G. (Chairman, Commonwealth Committee): Can the lecturer tell us the main reason for developing the power idea? He convinced me, in his very lucid lecture, of the value from the navigational standpoint, but he indicated that the fall between Lake Ontario and Lake Erie was something between three and four hundred feet, which was more than equivalent to the sum of the falls between Montreal and Kingston. I wonder whether he could indicate the main reason for having to spend large sums of money on the power side of the St. Lawrence waterway project.

THE LECTURER: I think I might say first why the power is needed. The drop between Lake Erie and Lake Ontario will be fully used when new power plants now under construction are completed. It is being used pretty well to the limit of the amount of water that can be diverted around Niagara falls without spoiling the scenery too much, and that was very carefully worked out in a treaty three years ago. It regulates the amount of water that can be diverted away from the falls. There is one figure for the amount of water that must go over the falls in the daytime in the tourist season, another figure for the night during the tourist season, and this reduced figure applies in the winter in daytime also. All the power that can be obtained from Niagara will soon be in operation.

Ontario, although it already has a good deal of hydro-electric power, has become short of power during and since the war, and has had to build a few thermal power stations using coal, which is almost twice as expensive, and if this continued it would gradually nullify one of the province's main economic advantages. It is true that the drop in water level is much less in the St. Lawrence than at Niagara. On the other hand, the volume of water is greater since it has gone through more of the drainage system and in the St. Lawrence almost all can be used. There will be a great deal more water to drop over the smaller height and, consequently, it will be possible to generate 2,200,000 horse-power at this one site, at Barnhart Island, as well as another million at Lachine, near Montreal.

MR. BERTRAND HEARN: What would be the position with regard to deep-water docks for ocean-going vessels in the Lakes?

THE LECTURER: There is a good deal of construction to be done. The cost of the navigation scheme, in a sense, could be partly defrayed by the money that each port will have to spend on its docking facilities, although some of that would probably be spent by the Federal Government too. The port of Montreal, incidentally, has become so crowded that it will need a good deal of improvement whatever happens.

MR. I. BERNHARD-SMITH: Would ships of all flags be allowed to use this project right up to the head of Lake Superior?

THE LECTURER: Yes. That does bring out the important point that there would be no discrimination against shipping of any country using the navigation works and whatever tolls are set would be the same for ships of all countries.

A vote of thanks to the Lecturer was carried with acclamation; and, another having been accorded to the Chairman, the meeting then ended.

THE SEED CRUSHING INDUSTRY

A paper by

E. G. WOODROOFE, Ph.D.,

Technical Director, The British Oil and Cake Mills, Ltd., read to the Society on Wednesday, 9th December, 1953, with G. Chipperfield, President, International Association of Seed Crushers, in the Chair

THE CHAIRMAN: The subject of our paper this afternoon is 'The Seed Crushing Industry', and the speaker is Dr. E. G. Woodroofe.

I have known Dr. Woodroofe for many years as a rising young physicist, as an efficient works manager and as an experienced technical director. I have always found that whenever any question arose, whether it concerned the quality of oil or the use of isotopes for checking trace minerals in animal feeding stuffs, Dr. Woodroofe always had all the answers ready. In short, he is an expert.

Having said that, perhaps I should allay some fears which may have arisen in the minds of some of the audience who may fear that his paper may be rather technical. Dr. Woodroofe's paper is in no way technical. It is intended for the layman; it is what the physicists call, for the benefit of ordinary people like myself, 'kids' stuff'. I think, therefore, you will all be able to understand what it is all about.

The seed crushing industry is something which most people do not know very much about. They ask, 'Why crush seeds anyhow?', or they say, 'Oh, you mean monkey nuts!'. They obviously have the idea in their minds that 'monkey nuts' are very largely grown for the zoological gardens.

It is not quite like that, however. Some 40,000,000 tons of seeds and nuts are grown and processed in some way or other in the world every year; 6,500,000 tons are exported to countries other than those in which they are produced; 1,250,000 tons are imported into this country. Dependent upon the seed crushing industry are not only the supply of oils for margarine, cooking fats, soaps, paints, linoleum, and many other commodities, but also a sufficiency of proteins for animal feeding stuffs to ensure the supply of farm livestock products, of butter itself, of milk, eggs, bacon, and so forth. In other words, here is an essential industry without which a modern community like ours could not exist.

The following paper, which was illustrated with lantern slides, was then read:

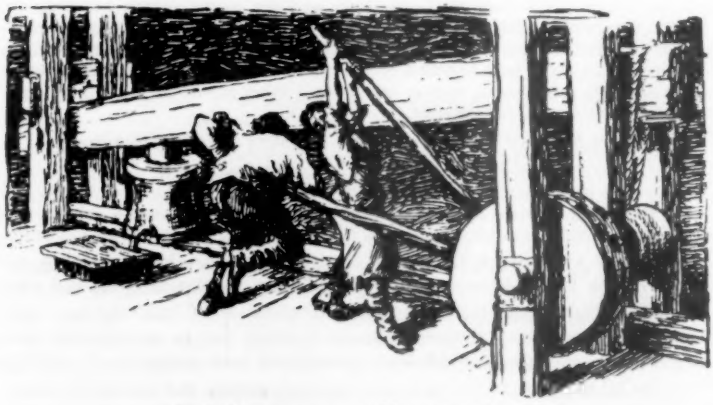
THE PAPER

HISTORY

In the year 1774, when the Adam brothers built the elegant building in Adelphi which has been occupied by your Society since that time, and two years before Washington made his famous Declaration of Independence, one of the subjects discussed at meetings in this building was an investigation into the possibility of expressing oil from groundnuts and sesame seed. Having shown the oil to be useful for wool combing, soap making and for illumination, the Society offered prizes for the importation of seeds and oils from the Colonies

of His Majesty King George III in America and in the West Indies, in order to encourage the growing of seed and expression of oil in those countries. This was followed a few years later by an offer of a prize for expressing oil from cottonseed. The resulting cake after expression was to be a 'strong and hearty food for cattle'. Although no one came forward to claim these prizes, the remarkable foresight of the Society can be fully appreciated when it is realized that more than a hundred years were to pass before these seeds were first commercially exploited in this country, and that they then made a material contribution to a major change in the pattern of the industry.

The idea of expressing oil from oil-bearing seeds was by no means new. Indeed, the oilseed crushing industry appears to be as old as the human race itself. Oil was essential for food, for anointing the body and as an illuminant. Probably the earliest existing record appears on the walls of the rock tombs of Beni Hassan in Middle Egypt dating back to 3000 B.C. Paintings show a large tourniquet type of arrangement supported by two vertical posts, and this was used for expressing juice from grapes or oil from olives by a wringing process. Another method, whose origin is lost in antiquity, but which is still practised in certain parts of the world to-day, is the process of rendering. This involves heating broken oilseeds, usually by means of boiling water, whereby some of the oil is freed and can be separated from the solid mass. It is interesting to note that a heating process still forms the basis of the pre-treatment of oilseeds in even the most modern industrial methods. The heat combined with moisture has the effect of weakening and rupturing the walls of the cells containing the oil, rather in the same way as steaming soft fruit bursts the skins to release the juice inside. During the Roman era, progress was made in developing methods for applying pressure to the heated seeds. A system of levers was first used and this method was later replaced by screw presses.



Early lever press operated by a capstan winch

Print of an early mill showing oil being expressed from olives by a screw press

At the time when the Society offered the aforementioned prizes, wedge presses had given place to stamper mills in this country. In the wedge press, pressure was applied to two bags containing the heated broken seed in an open box-like structure by driving a wedge into the open box.

Stamper mills were introduced from Holland, and these adopted the same principle but the driving was effected mechanically by means of vertical stampers, which were battering rams lifted by a cam shaft and allowed to fall freely to drive in the wedges.

Bramah's invention of the hydraulic press in 1795 completely revolutionized the processing methods of the industry, and hydraulic presses were well nigh in universal use up to the period between the two world wars. Many improvements in mechanizing the process were made during the early part of this century but the basic principle remained the same. The type of equipment which found the greatest favour was the Anglo-American press. The seed was first cooked in shallow 'pans' or 'kettles' after it had been broken by passing through rolls and was formed into shallow, rectangular moulds. It was then wrapped in woollen press cloths and filled into vertical presses. A pressure of about $\frac{3}{4}$-ton a square inch was applied to the mould for 30 to 45 minutes and oil was forced from the seed and cascaded down the press.

The men operating these plants found the work arduous since, when filling and emptying the presses, they had to lift and carry a considerable weight of hot material. The work was carried out at a prescribed speed agreed throughout

the whole industry. Moreover, with a process of this kind it was impossible to prevent spillage and men found themselves liberally coated with oily meal. As is to be expected with such a process, large numbers of men were necessary to operate these plants. All this has been changed by developments which have taken place during the last two decades.

MODERN PROCESSING METHODS

Expelling

Hydraulic press plants are fast disappearing and few still remain. These plants have been replaced by groups of so-called expellers in which the oil is expressed from the seed continuously and without manual effort. The expeller was invented at the turn of the century as a means of obtaining the easily yielding oil from certain seeds before hydraulic pressing. Since expelling was a very much cheaper process to operate than pressing, this technique found great favour as a pretreatment for seeds high in oil content. Experience in this field finally led to the development of expellers which are capable of giving yields of oil at least as good as those obtainable by hydraulic pressing and, in certain instances, even better.

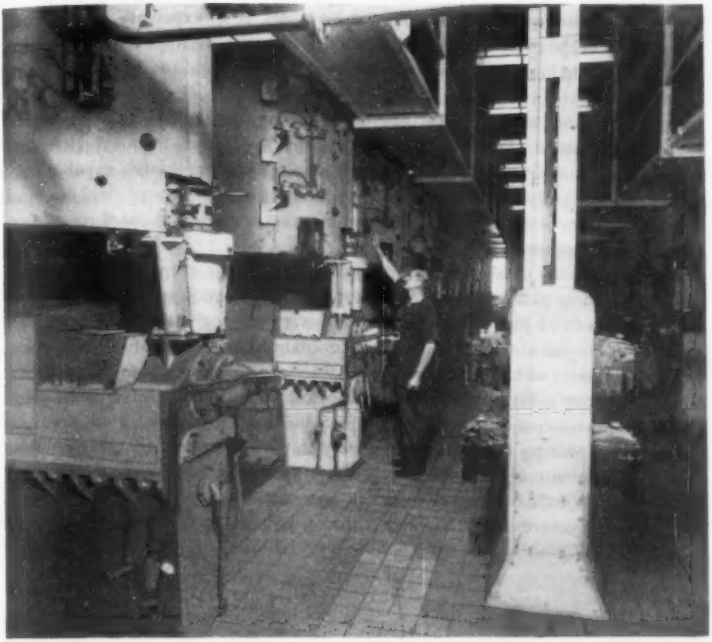
In many ways an expeller resembles a large elongated mincing machine. A central worm shaft drives the material from one end of the machine to the other. This worm shaft is contained within a cage formed by bars separated by fine clearances. The design of the worm shaft is such that pressure is steadily built up within the machine and this pressure is enhanced by causing the material to be extruded through a choke at the discharge end of the expeller. The pressure within the machine forces the oil from the seed through spaces between the bars of the cage and so effects the expression.

It is now possible to design mills with a continuous and fully automatically controlled flow of seed from storage bins through breaking rolls to cooking kettles and expellers. All stages of the process have been mechanized and the old heavy, manual operations have given place to supervisory attendance. Modern plants are clean, brightly lit and, more often than not, in a setting of tiled walls and floors.

Thus we find that the new process has made considerable improvements in conditions of working and has reduced labour costs. On the other hand, it carries with it the increased burden of maintenance costs normally associated with mechanization. A typical experience of replacement of hydraulic presses by expellers is that of a mill whose labour requirements fell to a quarter of the original establishment and, despite doubled maintenance expenses, achieved an overall reduction of 50 per cent in the direct processing costs, excluding depreciation.

Solvent Extraction

Another process which has made rapid strides is the solvent extraction technique. Petrol can be used as a solvent to remove oil from oilseeds in much the same way as it removes oily stains from garments. The first successful plant



Modern expeller mill

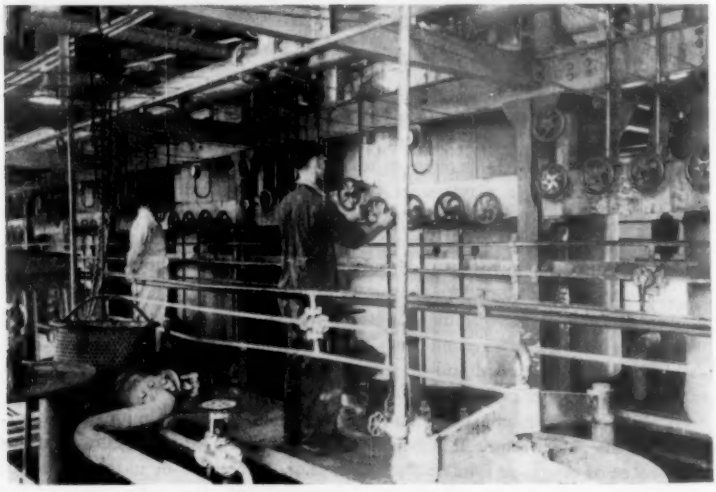
was erected in 1885 and it is interesting to note that this plant was in operation until early this year. This first plant was based on a batch process, the broken seed being filled into vessels of seven tons capacity in which it was washed with a petroleum solvent in a two-stage process. This method was superseded by a semi-continuous process whereby the extraction was carried out in a number of pots in series with a counter current flow of solvent through the pots. However, a variety of plants is now in use, all of which are truly continuous and in which the seed and solvent come into contact as streams flowing in opposite directions. Again, with extraction equipment it is possible to build fully mechanized mills which only require supervision from the operators. Whereas in the 'good old days' the presence of seed and oil was only too painfully obvious, in a modern extraction or expeller mill one has to search hard to see any evidence of either.

As with expelling, the extraction process employs a minimum of labour. Although the power required is usually about half that used in expelling, extraction can be as much as four or five times more expensive in usage of steam, which is required for freeing the meal from solvent after extraction and for distilling the mixture of solvent and oil to recover the solvent. Moreover, the

loss of petroleum solvent, inherent in the process, is an expensive item of cost, particularly at the present price of petrol. The unique advantage of the extraction process in giving higher yields of oil must be set against these additional processing costs.

For every 100 tons of palm kernels or groundnut kernels, the extraction process produces 2½ tons more oil than would be obtained from expellers, and for linseed the additional yield is as high as 4 tons. Even though expeller cake commands a slightly higher price than extracted meal, this greater yield is a most important consideration, since the prices of oils are usually about three or four times those of cakes.

For certain seeds of low oil content, such as soya beans, extraction must always prove to be more profitable, since the cost of expelling such seeds is exorbitantly high. For seeds of higher oil content, however, varying market conditions for oil and oilcake can swing the balance of profitability in favour of either process. The additional yield of oil from the extraction process, whose value to the oil miller is the differential between the prices for oil and oilcake, is balanced against the extra cost of obtaining this high yield. High prices for oil, resulting from scarcity during the immediate post-war period, have kept the pendulum swinging in favour of extraction for most oilseeds, but the peak of the swing has passed. Whether there is sufficient momentum to complete the reversal is open to conjecture, but farsighted is the oil miller who is equipped with both types of plant for not only does it give him versatility to treat any oilseed, but he is less vulnerable to the effects of fluctuating market conditions.

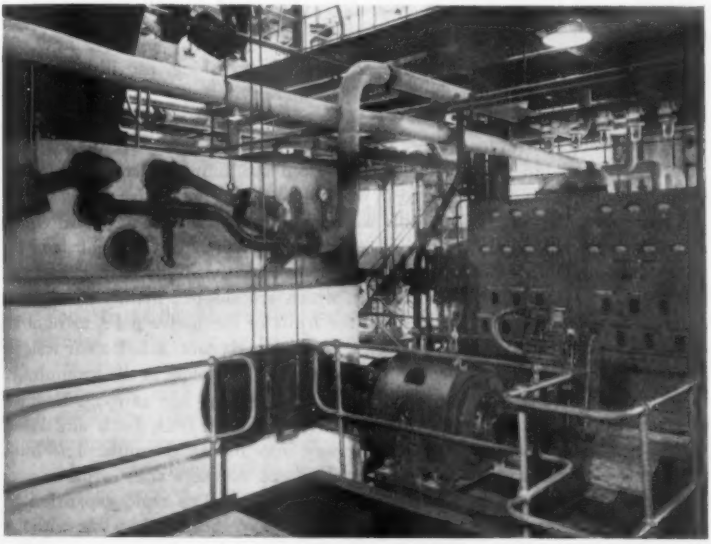


Extractor vessels and valve controls of a semi-continuous extraction plant

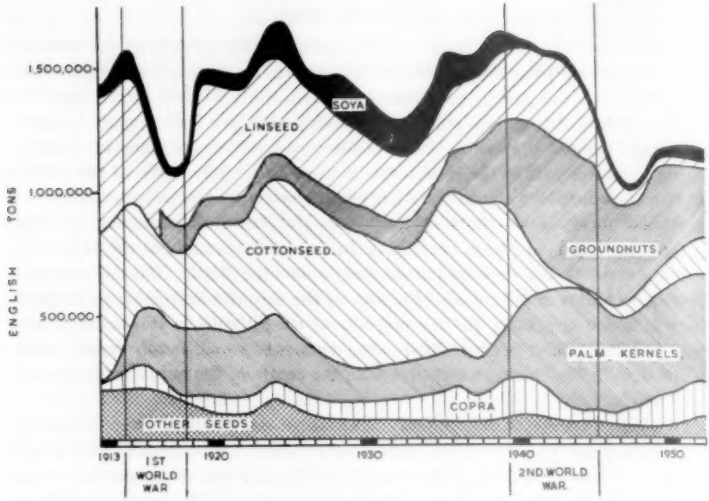
PATTERN OF TRADE

Mention has been made earlier of the change in the pattern of the industry which was taking place during the period leading up to the First World War, a change which was greatly accelerated by the conditions then forced upon the country. Before this period, cottonseed, linseed and, to a lesser extent, rapeseed constituted almost the entire crush. Cottonseed only came into prominence during the latter part of the nineteenth century and, whilst some of the oil was used for such purposes as frying and as a raw material for soap, much was exported in refined form to the Middle East and Mediterranean countries. Linseed, on the other hand, had been crushed in British mills throughout the eighteenth century, when it was imported from Russia and the Baltic. The oil was used for making paints and linoleum. Because of the favourable freights from Baltic ports, it is not surprising that the majority of the oil mills in this country were located in East Coast towns. There were numerous small, family owned mills. At one time in Hull alone, which was then the centre of the industry, there were thirty mills.

The main interest of the industry centred on the production of oilcake for cattle feeding and yields from the seeds crushed were in the region of 70 to 80 per cent, the oil being regarded almost as a by-product. Despite the changes which have taken place, this close link with the agriculture of the country continues



Typical modern continuous extraction plant of basket elevator type showing control panels and details of the construction of the extractor



Graphical representation of the trends in oilseed imports into the United Kingdom since 1913. (The small quantities of groundnuts imported before 1917 are included in 'other seeds')

to be maintained by the firms engaged in oilseed crushing, providing as they do animal feeding stuffs for the farming community.

When the country returned to a peace-time economy, a new emphasis was apparent. Many mills were crushing seeds especially rich in oil. Oil was required principally for edible purposes. Oilseeds from the Empire were much more prominent. Big mills had appeared in or close to the major British ports.

Even before the war, a few mills were processing small quantities of copra and palm kernels. Copra is the dried meat of the coconut and two-thirds of its weight is oil. It is imported from such areas as the Malay Straits, Ceylon and the islands of the South Seas. Palm kernels, which are shipped mainly from West Africa, are obtained after treatment of the fruits of the native palm to remove the red oil present in the fleshy pericarp. These kernels contain half their weight as oil. Another seed whose oil constitutes nearly half its weight is the groundnut, in which your Society tried to create an interest as long ago as 1774. Despite the fact that large tonnages of this seed were available from India and West Africa, negligible quantities found their way into British oil mills. The bulk of these seeds was exported to Continental oilseed crushers and, in particular, large tonnages were shipped to the port of Hamburg. The rapid expansion of the margarine industry on the Continent would have been impossible without these imports to supply vegetable oils, since the market for margarine had quickly outgrown the available supplies of animal fats which were the sole fatty constituents of the original product.

With the outbreak of war, no longer could copra, palm kernels and groundnuts grown in British Colonies be exported to Germany. Crushers in the United Kingdom had to adapt their plants to process these seeds. Moreover, the country was in dire need of oil for margarine and other edible purposes, as well as for soap with its important by-product glycerine. The result was that the imports of copra and palm kernels multiplied fivefold under the stress of wartime conditions and with groundnuts they represented over one-third of the total oilseeds processed in the country. The rapid expansion of the margarine industry was dependent on these basic raw material imports. These seeds continue to be the mainstay of the industry to-day.

There has been no return to the pre-1914 level of imports of linseed. Indeed, as a result of the economic and political changes during and subsequent to the Second World War, imports of this seed have declined to negligible proportions and cottonseed is no longer in the front rank. The large shipments of cottonseed from Egypt and linseed from the Argentine and India, once our main sources of supply of oilseeds, are no longer to be seen discharging in British ports. The cessation of exports of groundnuts from India in 1947 closed the door to a most important crop and although Nigeria—who is our main supplier—has increased her production, the total imports fall short of the demand for this most valuable oilseed.

No picture of the oilseed industry between the wars would be complete without mention of the remarkable soya bean which, together with cottonseed, dominates the American scene. This seed was first imported into Britain from the Far East in 1908 and gained the attention of oil millers almost immediately. On the outbreak of the First World War, it represented about 5 per cent of the total oilseed imports into the country. The seed contains only 17 to 18 per cent oil, but is highly valued, in particular for the protein-rich meal obtained after extracting the oil. As a result of the Japanese invasion of Manchuria in 1931 and of China in 1937, imports shrank and since then only isolated parcels of soya have been seen here. Imports were resumed on a modest scale in 1951.

With the cessation of shipments of linseed and rapeseed from Baltic ports, the importance of the East Coast crushing mills waned. New centres sprang up in the main ports, terminals of the busy trade routes to India, Africa, and the Far East. In particular, London and Liverpool became especially important, surrounded as they are by heavily populated and highly industrialized areas. As a result of this trend, many small mills up and down the East Coast have closed and large mills have taken their place in London, Liverpool and Glasgow. Hull has had to yield pride of place. In the city where once the clatter of the stamper mills reverberated throughout the night, the thirty mills which established her as the centre of the industry have dwindled to six.

FUTURE TRENDS

Availability of Oilseeds

So much for the past, but what lies ahead?

The world has recovered from the acute scarcity of oils and fats which prevailed during the post-war years. Production per capita of world population

has returned to the pre-war level and indeed during 1952 production was slightly in excess of world demand. Supplies of oilseeds to the United Kingdom in the immediate future are reasonably well assured, except for any temporary set-back, such as a major crop failure in West Africa.

However, during the past forty years there has been a chequered progress in setting up oil milling machinery in the growing areas and it is open to conjecture whether this trend might persist to the extent of affecting ultimately the availability of oilseed supplies to this country. Natural economic factors are not always allowed free play, particularly under the influence of an upsurge of nationalism. Subsidies, trade barriers and such general measures of protection complicate the issues involved. There is little doubt that capital investment to install oil milling machinery in oilseed growing countries is profitable to the extent of supplying the domestic market and possibly that of neighbouring non-industrialized regions. However, to produce for export is to plunge into uncertain waters. Under normal conditions, there can be no attraction for industrially advanced countries such as those in Europe to import oil and oil-cakes in place of oilseeds when they are well equipped with both plant and skilled labour to process seeds efficiently. European industries are based on processing raw materials. To buy processed products is to carry coals to Newcastle. The policy of exporting oil and oilcakes from seed-producing countries has undoubtedly been sustained by the world-wide shortages during and following the two World Wars. Industrialized countries, heavily engaged in the war effort, have no customer choice in view of the dire needs of their civil and military populations. Such conditions during the First World War fostered capital investment in oil mills in the Philippines and Dutch East Indies, but much of this equipment became redundant by the early twenties when oilseeds were plentiful. This experience would lead to the view that the supplies of raw materials to the oil milling industry in this country are unlikely to be affected by rival industries in seed-growing areas, unless governments are prepared to subsidize these industries permanently.

To present a complete picture, it would be appropriate to make a brief reference to other possible sources of fats, other than the well-known ones of animal origin, such as butter, lard, whale and fish oils. During the recent war the Germans synthesized fats from coal by-products and hydrocarbon greases. The process is complex and very costly, and the Germans found it impossible to eradicate a persistent sharp, burnt flavour, which made the fat unfit for edible purposes. As this product could never hope to vie with natural fats, it is highly improbable that this process will ever be resuscitated. A more promising development is the production of fat and of protein by the growth of simple organisms, such as yeasts, algæ and bacteria. The nutrients in which these micro-organisms have been grown usually contain, amongst other salts, ammonia which supplies the nitrogen to build up proteins and a carbohydrate, such as glucose or molasses, which is transformed into fat. As yet, the process is nowhere near the stage where commercial exploitation is possible and, of course, it may transpire that such a product could never be made to compete with vegetable and animal fats.

At the present stage of development it appears likely that fat produced from a small commercial unit would cost more than double the price of most vegetable oils.

Shortage of Liquid Oils

The paint, resin, linoleum and printing ink trades continue to be the main outlets for linseed and the so-called drying types of oils, which form hard coatings when exposed to air in thin films. The other oils, which represent a much greater tonnage, are used extensively for edible purposes and for soap. The demand for vegetable oils by the latter trade has certainly been reduced by the advances made by non-soapy detergents, but the demand in the edible field has more than offset this. In addition to providing the raw materials for margarine and shortenings, oils and fats play an essential role in such delectable products as biscuits, confectionery creams, chocolates, sweets and in frying a wide range of foodstuffs. The current unsatisfied demand for oils and fats in the United Kingdom has been estimated at 10 to 15 per cent of the present total consumption.

The vegetable oils which are available here in most plentiful supply, namely coconut, palm kernel and palm, are solid at normal temperatures, whereas those of more limited availability, such as groundnut, soya and cotton are liquid. This presents the industry with a problem, since a correct balance of solid and liquid is required for the production of margarine and cooking fats in order to endow the products with a plastic consistency over a long temperature range. This is a complete reversal of the problem which faced the margarine manufacturers in the early days of the development of that industry. Then there was a surplus of liquid oils. The chemical structure of oils, whereby certain of the links binding the carbon atoms together are double, accounts for the fact that they are liquid at normal temperatures. If at such linkages, one of the two links is broken and can be induced to hold hydrogen in chemical combination, the oil is transformed into a solid fat. The problem of surplus liquid oils was solved by the invention of just such a process, whereby the oil is made to combine with hydrogen in the presence of nickel which makes such a reaction possible, although the nickel undergoes no permanent chemical change. A solution to our present problem can be found by carrying out a chemical process in reverse to this, but any such process is likely to be most expensive. Therefore, in the future we can expect the seed crushing industry to show a greater interest in oilseeds yielding liquid oils, so long as these are freely available at the right price. Cotton-seed and soya-beans would satisfy the requirements, but if these are not available in sufficient quantities, interest will turn to such seeds as sunflower, maize-germ and safflower, small quantities of which have already been crushed here.

Protein for Animal Feeding Stuffs

Oilcake produced by the expelling process and meals from solvent extraction plants are eagerly sought after for animal feeding stuffs. The supplies from British mills are quite inadequate to meet the demand and large tonnages are imported. Of especial value are the cakes and meals from groundnuts, soya beans, linseed and cottonseed which are rich in protein, too rich to be fed directly

to animals except as part of a diet balanced by other feedstuffs. The science of animal nutrition has progressed far since the early days of the seed crushing industry when cottoncake and linseed cake for cattle were almost the only concentrated foods on the farm. Now, oilcakes are compounded with such commodities as cereals, bran, fishmeal, trace minerals and vitamins to produce feeds formulated to satisfy the particular nutritional requirements of the stock for which they are intended and to obtain maximum utilization of all ingredients of the diet.

The future is likely to see more and more research into the modification of processing techniques in order to obtain optimum growth effects from the protein present in the cakes and meals. Proteins consist of aggregates of amino-acids linked together to form very large molecules and the configurations of these molecules are modified by subjection to excessive heat for an adequate period of time. At high temperature the protein also interacts with some of the carbohydrate present in the meal and, if the temperature is sufficiently high, individual amino acids may be damaged. Some proteins are more sensitive to such treatment than others and in certain cases autoclaving, whereby the protein is virtually pressure-cooked, produces different effects to dry heat treatment. The nutritive value of the protein is changed when these molecular rearrangements and interactions take place and, in general, the effect of excessive heat treatment is to lower the feeding value of the protein. On the other hand, it has been shown that certain oilseeds, in particular soya beans and groundnuts, contain a trace of a material which combines with trypsin, which is a digestive ferment of the pancreatic juice, thereby inhibiting the digestion of a proportion of the protein in the stomach. This so-called trypsin inhibitor is destroyed by heat treatment and such treatment improves the nutritive value of certain meals. Thus it is necessary to devise for each oilseed processing conditions which will not only give a maximum oil yield of the right quality, but also so that the heat treatment, either during the process or in a supplementary process, is sufficient to eliminate the effect of any digestion inhibitor without reaching the stage where the nutritive value of the protein itself is affected. Much is already known but further work on this subject remains to be done.

This brief account of the use of protein for feeding animals leads to a consideration of the possibility of the utilization of proteins isolated from oilseed meals after solvent extraction of the oil. The United States has led the world in industrial exploitation of vegetable proteins and, although the total tonnage of meals used for this purpose will always be very small compared to that used in animal feeding stuffs, undoubtedly developments in this field will become of greater importance in the future.

Much of the success achieved in the United States results from close co-operation between industry on the one hand, and government and university research laboratories on the other. Whilst it is certain that this country could not afford the huge appropriations made to research in America, industry as a whole suffers under a comparative disadvantage due to the lack of close links with academic research.

Industrial and Edible Protein

A portion of the protein present in such meals as cottonseed, groundnut and soya, can be extracted by aqueous solutions and reprecipitated after the insoluble constituents of the meals have been removed by filtration. This precipitated product, known as isolated protein, has found a wide industrial application in the United States and much development work has been carried out in the edible field.

The behaviour of protein isolates in solution can be modified by heat and chemical treatments. It is in these modified forms that the proteins are used industrially. A very notable application in this country is the successful production of a synthetic wool from groundnut protein. This is a case of producing a vegetable protein fibre which simulates the properties of the natural protein fibre of the sheep. The skins of the groundnuts need to be first removed in order to obtain a white product and the oil extraction process is carried out at a low temperature in order to avoid adversely affecting the protein. After the protein extraction stage, a spinning solution of the protein is prepared in such a way that it can be pumped through spinnarets to form wool-like fibres which are subjected to a hardening process before drying. The resulting product has the warmth and resilience of wool and when used in admixture with monofilament synthetic fibres, such as viscose and rayon, it endows the material with these properties and with improved drape characteristics.

In the United States a number of firms are marketing soya protein isolates and amongst the main applications are those in paper coating, in adhesives and in water paints. In all these fields, soya protein has partially displaced casein, which is the protein derived from skimmed milk. In the paper-coating trade, casein is used to bind pigments to paper stock for high-quality coated paper. Such paper is used for expensive magazines, advertising brochures, speciality wrappings, etc. There appears to be no reason why protein derived from oilseeds should not equal the performance of casein with the advantage of consistency of quality, which casein lacks. As an adhesive, soya meal has found a profitable application as an ingredient in plywood glues and the protein isolate is beginning to be used as a fibre-board glue. The role it plays in water paints is quite different since here it is incorporated in the resin-emulsion and latex-emulsion type of paints in which it acts as a dispersing agent for the pigments and a stabilizer of the emulsion.

Soya flour has an established place as an ingredient in certain baked goods in which it serves to enrich the quality. The isolate has been used as a whipping agent for stabilizing a variety of products, such as confectionery creams. In this role it simulates the properties of egg albumen. Appetizing meat sauces have been produced from hydrolized soya protein isolates, and substitute meat products, such as hamburgers, are on sale in America. Milk and cheese-like products from a variety of plant proteins have featured prominently in the research work of some of the American universities and laboratories. Although complete success has not yet been achieved in producing a synthetic milk which will satisfy all the requirements for infant feeding in those countries where

supplies of milk are inadequate or unsatisfactory, remarkable progress has been made and many of the outstanding problems have been solved.

In the days ahead, much more will be heard of developments in the utilization of vegetable proteins derived from oilseeds. Experience has shown that success can only be achieved in this field when each project is backed by adequate and diligent research. The complexity of such research contrasts sharply with the simplicity of the terms of the original prize offers of the Royal Society of Arts, which visualized oilcakes as providing only 'strong and hearty food for cattle'.

DISCUSSION

MR. A. J. SIMPSON: Might I ask if there is any advantage in trichlorethylene over white spirit in the extraction plant?

THE LECTURER: Yes, there is an advantage in that trichlorethylene is non-inflammable and non-explosive, and so has a greater factor of safety.

On the other hand, it has certain disadvantages. It is more expensive, and the amount of steam used is slightly higher. Also degradation of a trace of the trichlorethylene might result in chlorine combining with the meal or oil. It is reported in some of the recent American literature that certain soya meals resulting from extraction with trichlorethylene have proved to be toxic to cattle.

These are some of the advantages and disadvantages of using trichlorethylene rather than petroleum.

MR. W. L. BLOOMFIELD: Is the solvent extraction the last word in oil milling, or are there any new processes on the way?

THE LECTURER: The only process which is completely new and which has been suggested as a possibility for treating oilseeds is the Chayen impulse rendering process which is in use for extracting fat from bones. The principle of the process is that the cells containing the fat are shattered by vibrations produced in a grinder with shortened beaters. The kibbled bones mixed with water are fed into the grinder and impulses are transmitted to the bones through the medium of the water. As a result of the shattering effect, fat is liberated from the bones and floats on top of the water as it flows away from the grinder. It has been suggested that such a process might find application in the seed crushing industry, but there are many complications.

Even if the process proved to be successful with oilseeds, if water was used it would be necessary to dry the wet meal, which is expensive. Moreover, the lecithin and soluble protein present in most oilseeds would act as stabilizers for the intractable emulsions which would be produced and which would be very difficult to split.

Of course, there is the possibility of using some other liquid which would not give rise to such emulsion troubles, but it is doubtful whether a satisfactory solution could be found along these lines even after extensive research.

Another possible technique is to use oil as the liquid phase, for instance, groundnut oil with groundnuts. I cannot imagine that this would be a very economic process, since centrifuges would be needed after the impulse rendering and the same result could be obtained more easily by means of low-pressure expellers.

I do not know of any other new techniques, although I seem to recall hearing before the war of someone who proposed investigating a method using micro-organisms. The walls of the cells containing the oil were supposed to be attacked and the oil released. It is probable that centrifuging would be necessary for the separation of the oil. I have heard nothing further of this process, so I presume it died a natural death from lack of success.

THE CHAIRMAN: If there are no more questions I think we can attribute it to the fact that Dr. Woodroofe has covered the ground in such a comprehensive manner.

It falls to me now not only to thank Dr. Woodroofe for the most interesting lecture which he has given, but to express our appreciation of the enormous amount of work involved in preparing such a lecture. I dare say many of you have already experienced that and will understand what I mean.

I should also like to thank the Royal Society of Arts for their initiative and hospitality in staging this talk here to-day. It gives a certain amount of advertisement, of course, to our industry which we do not often get. Whether it does us any good or not I do not know; it remains to be seen.

I should also like personally to thank the Society for the privilege of presiding in this historic hall. It is something I know that I shall remember with very great pleasure.

The vote of thanks to the Lecturer was carried with acclamation.

SIR JOHN SIMONSEN F.R.S. (A Vice-President of the Society): I have the privilege this afternoon of asking you to give your applause to our chairman for having so kindly presided at our meeting. It has been a great meeting and much of its greatness has come not only from the lecturer, but from the chairman who has very kindly—he is a busy man—come here this afternoon.

On behalf of the Society I should like to offer my sincere thanks.

The vote of thanks to the Chairman was carried with acclamation and the meeting then ended.

GENERAL NOTES

FLEMISH ART AT THE ROYAL ACADEMY

A quarter of a century has passed since the Royal Academy's last exhibition of Flemish art, which included tapestries and works up to 1900. It was not too soon then to assemble another great miscellany of Flemish art, this time from 1300 to 1700, which follows naturally on the Dutch exhibition last winter. The task of gathering so many fragile works from Bruges, Brussels, and Antwerp, from museums in France, Italy, and Austria, cataloguing and hanging them with exemplary care, and returning them unharmed, is alarming even to contemplate; and to Sir Gerald Kelly and his associates, not least Mr. Humphrey Brooke, the public's gratitude is due for this annually recurring miracle.

Though more thinly represented than in 1927, the Primitives are nevertheless finely chosen and include, besides Jan Van Eyck's celebrated portrait of his wife, from Bruges, Memling's Donne triptych and his Floreins altarpiece. Add to these almost a hundred Van Dycks—outnumbering and frequently outshining his master Rubens, many of whose finest works have been required for his exhibition in Rotterdam—a feast of illuminated manuscripts collected by Dr. Pächt, and several of the most important paintings of the elder Pieter Brueghel, and you have the outstanding features of the Academy's exhibition.

On these occasions it is remarkable, however, how often one is attracted to panels of secondary importance. The small copy of Robert Campin's triptych of *The Deposition*, for instance, with its emphatic pattern and hard angularity, is not the least impressive of the Primitives in the first room, relieved by the tender sentiment of Memling and the curiosity of a fifteenth century portrait of *Edward Grimston*, by Petrus Christus, possibly the earliest picture of any private English gentleman. Here, too, Gerard David's panels of the *Legend of St. Anthony of Padua* take the eye for the telling use he makes of the saint's grey habit contrasted with robes of pink.

One of the versions of The Fall of Icarus *by the elder Pieter Brueghel lent to the Flemish Exhibition at the Royal Academy*

In the south rooms is a much wider choice of Italianate pictures of the sixteenth century, with their curious echoes of the Renaissance. The tastelessness of the Italianizers is most apparent in Van Orley's accumulation of detail, and the preposterous ornamentation of an Antwerp panel possibly by the same hand; but there is also a number of fine paintings by the enlightened humanist Quentin Matsys, and others by his eclectic, but authoritative follower Joos van Cleve, whose self-portrait in the Octagon, lent by the Queen, should not be missed.

For Roger Fry, the originality of Van Dyck 'consisted in abandoning the higher purposes of painting and directing himself to a kind of superior millinery. . . . His was the most discreetly courtierlike, the most politely subservient art that had yet been created'. It is curious how exaggerated such passages in Fry's memorable Flemish lecture, given a quarter of a century ago, seem in the light of the present exhibition. No doubt Van Dyck was at his best when most under Italian influence, as in the great baroque *Ecstasy of St. Augustine* from Antwerp, with its clear echo of Titian. But the artist's English portraiture in the main gallery, where the Court and family of Charles I are assembled, testifies not merely to his acknowledged fluency and elegance, but also to his unerring grasp of form and insight into character. There is no hint of subservience in that portrait of Charles I from Arundel, perhaps the most discerning and informal of them all. Nor could any gesture be less affected than that with which the Countess of Carlisle twitches aside the curtain that it may continue the flowing rhythm of her dress, nor understanding deeper than his character reading of *Lords John and Bernard Stuart*, surely his most eloquent portrait group painted in England.

In Gallery VI Van Dyck's Italianate compositions actually discountenance the earthly *Nativity* of Rubens, who shines intermittently here, chiefly in the several wonderful landscapes and portraits. But as evidence of the flexibility of Rubens'

style, there is his *Lioness at Play* (lent by Lord Normanton), a canvas which exhibits a splendid breadth of design while missing nothing. Several of his fine studies are shown in the room of drawings which again, it must be said, is dominated by his brilliant pupil with sixteen *grisaille* portrait-sketches for the *Iconography*.

Only where he is seen, as in Gallery IX, among his contemporaries, can we judge the true stature of the elder Pieter Brueghel. In the spacious *Flight into Egypt*, in the versions of *The Fall of Icarus*, in the intense radiance of his symbolic *Dulle Griet*, one encounters his most imaginative beauty and the complexity of his mind. Brueghel's is an art that will continue to accord with the romantic spirit in every age, as it has in ours; and we may believe that something of his fantasy has animated artists as disparate as Christopher Wood and Mr. Stanley Spencer. Neither Teniers can match for an instant the movement, the solidity, the delicate colours of Brueghel's country folk drifting and gossiping across a landscape on the way to *The Peasants' Wedding*. So absorbing is he, that it is unfortunate one has little time for the crude horse-play and, worse, the indifferent organization of Adriaen Brouwer's groups when he essayed anything larger than a very small scale. Studying his tavern scene here, with its wholely unrelated foreground figures, and another composition which falls in half, one may well consider that Brouwer's art has been greatly overrated.

Like its predecessors, this winter exhibition does in fact offer a unique occasion to revise our estimates of the masters, particularly the less familiar ones; and visitors curious to explore them further are referred to Mr. Horace Shipp's new book, reviewed elsewhere, which has been aimed to coincide with this memorable collection.

NEVILE WALLIS

CORRESPONDENCE

THE BRITISH ACADEMY OF ARTS IN ROME*

From LIEUTENANT-COLONEL ION S. MUNRO, O.B.E., 4 LLOYD SQUARE, W.C.1.

The Hon. General Secretary of the British School at Rome, Mr. W. D. Sturch, has kindly furnished me with documents to throw more and better light on the founding of the School and the attitude of the Academy.

During 1910–11, the 1851 Commissioners developed their proposals for the creation of a new entity to be called 'The British School at Rome'. The British Archæological School in Rome and the British Academy of Arts in Rome were invited to adhere. On 10th January, 1912, the Academy appointed a special committee to give effect to the amalgamation scheme. On 7th February the Academy approved transfer of its property and funds, and submitted 'recommendations' concerning the future of its students, the continuance of its life classes, and the inclusion of existing Academy Trustees within the framework of the new School. On 12th June of the same year the British School Charter received Royal consent. The Charter notes the British Academy's desire to join and, in a finance clause, records that all Academy property and funds will be vested in the new corporation.

Whether the Academy Special Committee failed to present or did not succeed in negotiating the Academy 'recommendations' remains in obscurity, and may be one of the secrets only to be found in the missing deed box; but it seems safe to assume that it was the difficulty of meeting these 'recommendations' under which the amalgamation lapsed, and the Academy continued on its traditional lines.

It was not until 8th June, 1929, that an Order in Council deleted the finance clause of the 1912 School Charter and retransferred the property rights mentioned therein to the Academy.

* Colonel Munro's lecture on this subject was published in the last issue of the *Journal*, pp. 42–56.

NOTES ON BOOKS

THE FLEMISH MASTERS. *By Horace Shipp. George Newnes*, 1953. 25*s*

Mr. Horace Shipp's new book is, as he allows, a *pièce d'occasion*, but its value to the general reader will remain long after the Royal Academy's exhibition of Flemish art has closed. The colour and monochrome plates are as just as one would expect to find in a popular production, the text page is clear, and the index sufficient. In something over a hundred pages the two great ages of Flemish art, and much in between them, receive the attention of a critic who is also a born journalist.

Indeed *Apollo's* art critic is more; he is a novelist, as was Marriott of *The Times*; but the easy style and felicities of expression that come so naturally to the author do not for a moment disguise his genuine understanding of the subject. Still, it is a human no less than an artistic narrative that will beguile the ordinary reader, from the flowering of Flemish art in the early illuminators and Primitives to its culmination in the painting of Rubens and Van Dyck, and what Mr. Shipp calls (with little respect for their successors) 'the end of the Flemish story'.

NEVILE WALLIS

FROM THE JOURNAL OF 1853

VOLUME II. 16*th December*, 1853

From a paper by John Joseph Mechi *on* British Agriculture, with some account of his own operations at Tiptree-Hall Farm.

. . . But for all that, I have 'a crow to pull with our Yankee friends'. Would you believe it, they brought over with them horse-gear to work their [threshing] machine, and tell me that their 'cute Agricultural friends in the States' are universally 'minus steam'. Of course, I felt much shocked, and having attached a small portable steam-engine of four horse power to show them the advantage over a relay of eight horses, they felt duly ashamed, and promised never again to permit horses to work their excellent machine.

Some Activities of Other Societies and Organizations

MEETINGS

TUES. 5 JAN. British Architects, Royal Institute of, 66 Portland Place, W.1. 6 p.m. John Betjeman : *Honour your Forebears.*

Chemical Engineers, Institution of, at the Geological Society, Burlington House, W.1. 5.30 p.m. J. Johnston : *Some Mechanical Handling Problems in the Chemical Industry.*

Civil Engineers, Institution of, Great George Street, S.W.1. 5.30 p.m. J. F. Hagrup : *Swedish Underground Hydro-Electric Power Stations.*

Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. (1) K. Kandiah : *A Scaling Unit Employing Multi-Electrode Cold-Cathode Tubes and a Sensitive Pulse Trigger Circuit with a Stable Threshold.* (2) F. S. Goulding, J. C. Hammerton, M. G. Kelliher and A. W. Merrison : *The Development of a Neutron Spectrometer for the Intermediate Energies.*

THURS. 7 JAN. Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. H. Leyburn : *Continuity of Electricity Supply.*

Engineering Inspection, Institution of, at the Royal Society of Arts, W.C.2. 6 p.m. E. G. West : *The Work of the Aluminium Development Association.*

Metals, Institute of, 4 Grosvenor Gardens, S.W.1. 6.30 p.m. A. I. M. King : *The Rogerstone Strip Mill.*

OTHER ACTIVITIES

WED. 6 JAN., 1954. Building Centre, 26 Store Street W.C.1. 12.45 p.m. Film Show : *Keeping out the Water.*

NOW UNTIL THURS. 31 DEC. Whitechapel Art Gallery, Exhibition : *East End Academy—1953.*

NOW UNTIL SUN. 3 JAN., 1954. Imperial Institute, South Kensington, S.W.7. Exhibition : *Loyal Addresses Presented to Her Majesty by the Colonial Peoples on the Occasion of Her Coronation.*

NOW UNTIL SUN. 17 JAN., 1954. Science Museum, S.W.7. Exhibition : *Navigation To-Day.*

NOW UNTIL 23 JAN., 1954. Arts Council, at the New Burlington Galleries. Exhibition : *Contemporary Art in Finland.*

NOW UNTIL APR., 1954. Victoria & Albert Museum, S.W.7. Exhibition : *Bazaar Paintings from Calcutta.*